

CLAIMS

1. A non-aqueous electrolytic solution for a lithium secondary battery comprising an electrolyte in a non-aqueous solvent comprising a cyclic carbonate compound, a linear carbonate compound and a cyclohexylbenzene compound having a benzene ring to which one or two halogen atoms are attached, wherein a volume ratio of the cyclic carbonate compound and the linear carbonate compound in the non-aqueous solvent is in the range of 20:80 to 40:60.
2. The non-aqueous electrolytic solution of claim 1, wherein the cyclic carbonate compound comprises at least two compounds selected from the group consisting of ethylene carbonate, propylene carbonate, butylene carbonate, vinylene carbonate, dimethylvinylene carbonate and vinylethylene carbonate.
3. The non-aqueous electrolytic solution of claim 1, wherein the cyclic carbonate compound comprises at least one compound selected from the group consisting of vinylene carbonate, dimethylvinylene carbonate and vinylethylene carbonate, and at least one compound selected from the group consisting of ethylene carbonate, propylene carbonate and butylene carbonate.
4. The non-aqueous electrolytic solution of claim 1, wherein the linear carbonate compound comprises at least one compound selected from the group consisting of methyl ethyl carbonate, dimethyl carbonate and diethyl carbonate.

5. The non-aqueous electrolytic solution of claim 1, wherein the cyclohexylbenzene compound has a benzene ring to which one or two fluorine atoms are attached.

5 6. The non-aqueous electrolytic solution of claim 1, wherein the cyclohexylbenzene compound comprises at least one compound selected from the group consisting of 1-fluoro-2-cyclohexylbenzene, 1-fluoro-3-cyclohexylbenzene and 1-fluoro-4-cyclohexylbenzene.

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7. The non-aqueous electrolytic solution of claim 1, wherein the non-aqueous electrolytic solution has a dynamic viscosity at 25°C in the range of 2.3×10^{-6} to 3.6×10^{-6} m²/s.

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8. A non-aqueous electrolytic solution for a lithium secondary battery comprising an electrolyte in a non-aqueous solvent comprising a cyclic carbonate compound, a linear carbonate compound and a cyclohexylbenzene compound having a benzene ring to which one or two halogen atoms are attached, wherein the non-aqueous electrolytic solution further contains a branched alkyl benzene compound in an amount of 0.01 wt.% to 3 wt.%.

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9. The non-aqueous electrolytic solution of claim 8, wherein the cyclic carbonate compound comprises at least two compounds selected from the group consisting of ethylene carbonate, propylene carbonate, butylene carbonate, vinylene carbonate, dimethylvinylene carbonate and vinylethylene carbonate.

10. The non-aqueous electrolytic solution of claim
8, wherein the cyclic carbonate compound comprises at
least one compound selected from the group consisting of
vinylene carbonate, dimethylvinylene carbonate and vi-
5 nylethylene carbonate, and at least one compound selected
from the group consisting of ethylene carbonate, propyl-
ene carbonate and butylene carbonate.

11. The non-aqueous electrolytic solution of claim
10 8, wherein the linear carbonate compound comprises at
least one compound selected from the group consisting of
methyl ethyl carbonate, dimethyl carbonate and diethyl
carbonate.

15 12. The non-aqueous electrolytic solution of claim
8, wherein the cyclohexylbenzene compound has a benzene
ring to which one or two fluorine atoms are attached.

13. The non-aqueous electrolytic solution of claim
20 8, wherein the cyclohexylbenzene compound comprises at
least one compound selected from the group consisting of
1-fluoro-2-cyclohexylbenzene, 1-fluoro-3-cyclohexylben-
zene and 1-fluoro-4-cyclohexylbenzene.

25 14. The non-aqueous electrolytic solution of claim
8, wherein the non-aqueous electrolytic solution has a
dynamic viscosity at 25°C in the range of 2.3×10^{-6} to
 $3.6 \times 10^{-6} \text{ m}^2/\text{s}$.

30 15. The non-aqueous electrolytic solution of claim
8, wherein a volume ratio of the cyclic carbonate com-
pound and the linear carbonate compound in the non-
aqueous solvent is in the range of 20:80 to 40:60.

16. The non-aqueous electrolytic solution of claim
8, wherein the branched alkylbenzene compound comprises
at least one compound selected from the group consisting
of isopropylbenzene, cyclohexylbenzene, tert-butylben-
5 zene, 1,3-di-tert-butylbenzene, tert-pentylbenzene, 4-
tert-butylbiphenyl, tert-pentylbiphenyl, bis(4-tert-
butylphenyl) ether and bis(4-tert-pentylphenyl) ether.

17. The non-aqueous electrolytic solution of claim
10 8, wherein the weight ratio of the branched alkylbenzene
compound to the cyclohexylbenzene compound is in the
range of 0.1 to 1.

18. A lithium secondary battery comprising a posi-
15 tive electrode, a negative electrode and the non-aqueous
electrolytic solution defined in claim 1.

19. A lithium secondary battery comprising a posi-
tive electrode, a negative electrode and the non-aqueous
20 electrolytic solution defined in claim 8.

20. A method of using a lithium secondary battery
comprising a positive electrode, a negative electrode and
the non-aqueous electrolytic solution defined in claim 1,
25 which comprises repeating charge and discharge of the
battery under a charging condition that a charging
termination voltage is 4.2 V or higher.

21. A method of using a lithium secondary battery
30 comprising a positive electrode, a negative electrode and
the non-aqueous electrolytic solution defined in claim 8,
which comprises repeating charge and discharge of the
battery under a charging condition that a charging
termination voltage is 4.2 V or higher.